

**NEBRASKA DEPARTMENT OF HEALTH AND HUMAN SERVICES**  
**DIVISION OF PUBLIC HEALTH**  
**X-RAY PROGRAM**

**EQUIPMENT PERFORMANCE EVALUATION**  
**DENTAL UNIT**

Registration Number \_\_\_\_\_ Date \_\_\_\_\_  
 Name of Registrant \_\_\_\_\_

Registration Number of Service Company \_\_\_\_\_  
 Service Company \_\_\_\_\_

Survey instrument used \_\_\_\_\_ Calibration date \_\_\_\_\_

Type of measuring device: External Probe (ion chamber) \_\_\_\_\_  
 Ion Chamber within a housing \_\_\_\_\_  
 X-ray unit identification (control panel): \_\_\_\_\_  
 Manufacturer Model No. \_\_\_\_\_  
 Serial No. \_\_\_\_\_ Location \_\_\_\_\_

**TIMER ACCURACY**

The accuracy of the timer must meet the manufacturer's specifications. If the manufacturer specifications are not obtainable, the timer accuracy must be within 10% of the indicated time with the testing performed at 0.5 second.

Timer accuracy determined by (select which one used):

Manufacturer's timer deviation tolerance \_\_\_\_\_ **OR**  
 10% tolerance with testing performed at 0.5 second (.500 milliseconds)

Time used for testing \_\_\_\_\_ mS \_\_\_\_\_ Pulses  
 Perform four measurements at the above time setting:  
 \_\_\_\_\_ milliseconds/pulses  
 \_\_\_\_\_ milliseconds/pulses  
 \_\_\_\_\_ milliseconds/pulses  
 \_\_\_\_\_ milliseconds/pulses

**EXPOSURE REPRODUCIBILITY**

When all technique factors are held constant, the coefficient of exposures for both manual and AEC systems must not exceed 0.05.

$$C = \frac{s}{\bar{x}} = \frac{1}{\bar{x}} \left[ \frac{\sum_{i=1}^n (x_i - \bar{x})^2}{n-1} \right]^{1/2}$$

Technical Factors Selected: \_\_\_\_\_ ma \_\_\_\_\_ kVp \_\_\_\_\_ time  
 Output Measurements:

\_\_\_\_\_ mR  
 \_\_\_\_\_ mR  
 \_\_\_\_\_ mR  
 \_\_\_\_\_ mR

s = estimated standard deviation of the population  
 X = mean value of observations in sample  
 Xi = ith observation in sample  
 n = number of observations in sample.

## KVP TEST

The indicated kVp must be accurate to within 10% of the indicated setting at no less than three points over the usual operating range of the machine. For units with fewer than three fixed kVp settings, the units shall be checked at those settings.

Indicated kVp _____	Measured kVp _____	Deviation _____ %
Indicated kVp _____	Measured kVp _____	Deviation _____ %
Indicated kVp _____	Measured kVp _____	Deviation _____ %
Indicated kVp _____	Measured kVp _____	Deviation _____ %

$$((\text{Measured kVp} - \text{Indicated kVp}) \div \text{Indicated kVp}) \times 100 = \% \text{ Deviation}$$

Measured kVp within " 10% of the indicated setting: Yes ( ) No ( )

## TUBE STABILITY

The tube must remain physically stable during exposures. In cases where tubes are designed to move during exposure, the registrant must assure proper and free movement of the unit.

Tube stable in all orientations: Yes ( ) No ( ) Free movement where designed: Yes ( ) No ( )

## COLLIMATION

Field limitation must meet the requirements of 180 NAC 21

**Intraoral:**

Minimum source to skin distance (SSD) \_\_\_\_\_ cm.

Field size at tip of cone cm.

Field size to 7 cm.: If the minimum SSD is 18 cm or more Yes ( ) No ( ) N/A ( )

Field size	to 6 cm.: If the minimum SSD is less than 18 cm	Yes ( )	No ( )	N/A ( )
------------	---	---------	--------	---------

**Panoramic:**

X-ray field misalignment at image receptor slit: \_\_\_\_\_ in. X \_\_\_\_\_ in.  
(transverse) (vertical)

Misalignment cannot exceed 0.0 inches in the transverse axis: In compliance Yes ( ) No ( )

Misalignment cannot exceed 0.5 inches in the vertical axis: In compliance Yes ( ) No ( )

**Cephalometric:**

Source to image distance (SID) \_\_\_\_\_ in./cm.

Indicated field size in./cm. X \_\_\_\_\_ in./cm.

Measured field size in./cm. X            in./cm.

Misalignment	in./cm. X	in./cm.
--------------	-----------	---------

Does misalignment exceed 2% of the SID: Yes ( ) No ( )

**ENTRANCE EXPOSURE (EE) (See Form NRH 21B for instructions)**

EE levels-

Technique Factors selected: kVp \_\_\_\_\_ mA(s) \_\_\_\_\_ time \_\_\_\_\_ (for intraoral bite wing only)

Source to Skin Distance (SSD): \_\_\_\_\_ in/cm Source to Detector Distance (SDD): \_\_\_\_\_ in/cm

Is tip of cone positioned  $\frac{1}{2}$  inch or less from surface of instrument housing or probe? Yes ☐ No ☐

EE	mR	Calculated Measurement	Direct Measurement
0.00	0.00	0.00	0.00
0.05	0.05	0.05	0.05
0.10	0.10	0.10	0.10
0.15	0.15	0.15	0.15
0.20	0.20	0.20	0.20
0.25	0.25	0.25	0.25
0.30	0.30	0.30	0.30
0.35	0.35	0.35	0.35
0.40	0.40	0.40	0.40
0.45	0.45	0.45	0.45
0.50	0.50	0.50	0.50
0.55	0.55	0.55	0.55
0.60	0.60	0.60	0.60
0.65	0.65	0.65	0.65
0.70	0.70	0.70	0.70
0.75	0.75	0.75	0.75
0.80	0.80	0.80	0.80
0.85	0.85	0.85	0.85
0.90	0.90	0.90	0.90
0.95	0.95	0.95	0.95
1.00	1.00	1.00	1.00

Signature of surveyor: \_\_\_\_\_ Date: \_\_\_\_\_

## DETERMINING THE ENTRANCE EXPOSURE (EE) FOR INTRAORAL DENTAL EXAMINATIONS

### A. DETERMINING ENTRANCE EXPOSURE BY CALCULATION:

Note: Ion chambers may be located within the instrument housing rather than within an external probe. In this situation the distance from the top surface of the housing to the ion chamber below must be known. If this type of instrument is used for the EE measurements, the inverse square law must be utilized for accurate results.

$$EE = mR(\text{measured}) \times (SDD \div SSD)^2$$

Where: EE = entrance exposure

mR (measured) = indicated exposure on measuring instrument

SDD = source (target) to detector (ion chamber) distance

SSD = source (target) to skin distance

- (a) Place the tip of the cone within ½ inch from the housing of the measuring instrument.
- (b) Measure the distance from the source to the entrance/tube side surface of the housing.
- (c) Determine the distance from the source to the ion chamber within the housing.
- (d) Convert all measurements to the same unit. (i.e., Do not use the SDD in inches and the SSD in centimeters.)
- (e) Select the kVp, mA, and time normally used for an intraoral bite wing x-ray at that facility. Document the selected technique factors.
- (f) Make an exposure and document the measurement in millirem.
- (g) Using the above formula, calculate the EE.

### B. DETERMINING ENTRANCE EXPOSURE BY DIRECT MEASUREMENT:

Note: Use this procedure only if an external probe (ion chamber) is available for the measurements.

- (a) Position the tube so the end of the cone is not greater than ½ inch from the probe. Do not put the probe inside the cone or allow the cone to have direct contact with the probe.
- (b) Select the kVp, mA, and time normally used for an intraoral bite wing x-ray at the facility. Document the selected technique factors.
- (c) Measure the distance from the target (source) to the end of the cone. Document this distance.
- (d) Make an exposure and document the radiation output in millirem. This direct measurement is the entrance exposure.

### EXPOSURE REPRODUCIBILITY CALCULATIONS

$$C = \frac{s}{\bar{x}} = \frac{1}{\bar{x}} \left[ \frac{\sum_{i=1}^n (x_i - \bar{x})^2}{n-1} \right]^{1/2}$$

EQUATION

Where:

$\underline{s}$  = Estimated standard deviation of the population.

$\bar{x}$  = Mean value of observations in sample.

$x_i$  =  $i^{\text{th}}$  observation in sample.

$n$  = Number of observations in sample.

In this example, the exposures are considered to be reproducible.

Example:

The four ( $n$ ) exposures ( $X_i$ ) measured 409 mR, 387 mR, 391 mR, and 410 mR.

STEP 1 Determine the mean value ( $\bar{X}$ ) of the four exposures taken.

$$(409 \text{ mR} + 387 \text{ mR} + 391 \text{ mR} + 410 \text{ mR}) \div 4 = 399.25 \text{ mR}$$

STEP 2 Find the difference between each exposure and the mean value (disregard sign).

409.00 mR	387.00 mR	391.00 mR	410.00 mR
<u>-399.25 mR</u>	<u>-399.25 mR</u>	<u>-399.25 mR</u>	<u>-399.25 mR</u>
9.75 mR	12.25 mR	8.25 mR	10.75 mR

STEP 3 Square each of the differences

$9.75^2 = 95.06$	$12.25^2 = 150.06$
$10.75^2 = 115.56$	$8.25^2 = 68.06$

STEP 4 Divide each number by 3 ( $n-1$ ) and add the results

$95.06 \div 3 = 31.69$
$150.06 \div 3 = 50.02$
$68.06 \div 3 = 22.69$
$115.56 \div 3 = 38.52$
<u>143.11</u>

STEP 5 For  $s$ , determine the square root of the above number

$$\sqrt{143.11} = 11.96$$

STEP 6 Divide  $s$  by the mean value ( $\bar{X}$ )

$$11.9629 \div 399.25 = .0299 = c = \text{the coefficient of variation}$$

STEP 7 If  $c=0.05$  or less, the exposures are considered to be reproducible